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an account of the general aspect of the equatorial African forest, a technical description of the timber resources, and a discussion of the botanical relationships of the trees.

Part 3 is devoted to methods of exploitation, and Part 4 to the silviculture and management of the colonial forests. In Part 5 the technological classification of colonial timbers is treated, and Part 6 presents the conclusions of the mission regarding the utilization of the colonial forests.

It will be inferred from the foregoing abstract of its contents that this book is primarily of interest to foresters and persons having a manufacturing or commercial interest in tropical forest products. This follows from the definitely economic object of the mission and the circumstances under which it was organized. Professional geographers will turn to other sources for information concerning these colonies, although the student of plant geography will find in the second part of Volume 3 data on the botanical composition of the forests of tropical West Africa.

T. H. KEARNEY

THE COAST AND ISLANDS OF FORMER GERMAN EAST AFRICA

EMIL WERTH. **Das Deutsch-Ostafrikanische Küstenland und die vorgelagerten Inseln.** Vol. 1, xvi and 334 pp.; map, diagrs., ill., bibliogr.; Vol. 2, vii and 265 pp.; maps, ill., index. Dietrich Reimer (Ernst Vohsen), Berlin, 1915. 10 x 7 inches.

This valuable work, describing the coast of the late German East Africa with its length of nearly 500 miles and its three large offshore islands, is based on the author's own observations, which continued over a number of years, and is extended by selections from studies of others. One of the chapters is analyzed below. The half-tone plates are good as a rule; the text figures are mediocre or poor; a bibliography of some thirty titles, some of them rather irrelevant, is given near the beginning of the first volume; the index at the end of the second is exceptionally full. There are no page headings, and the modern style of Roman type from which the book is printed is unattractive. The accompanying maps are of high value. Two are on a scale of 1:500,000, with flowing 50-meter contours, one of these showing the geology in nine colors; the other, in six colors, shows the distribution of vegetation, which seems to be closely related to the geology. A third map, on a scale of 1:2,000,000, exhibits the distribution of native culture. The plan of treatment is as follows. The first volume is occupied with a systematic account of various topics beginning with the near-shore sea (12 pp.); then come the structure and form of the coastal belt, from 20 to 40 miles wide, and of the large islands of Pemba, Zanzibar, and Mafia (88 pp.); next the climate (37 pp.), flora (57 pp.), and fauna (39 pp.); and finally the native tribes (152 pp.) and products and trade (75 pp.). The second volume is occupied with descriptions of six physiographic districts and their subdivisions, in which the topics that were separately treated in the first volume are presented in their natural relations; but the enchainment of the different topics is not brought out here so emphatically as one might wish.

The author shows himself to be broadly familiar with many subjects and sets forth much information in technical form that must be interesting to specialists in various sciences; but if the other chapters are not handled more skillfully than the chapter on geological structure and topographic form, here reviewed in some detail, they will be disappointing, even if instructive, to their readers. That chapter attempts to give a genetic account of the land forms, but the attempt is not altogether successful because the reader has to plow through too much explanatory argument before he reaches the things explained; and the plowing is sometimes difficult by reason of the involved construction of subordinate clauses. In some respects the sequence of treatment is unsatisfactory: for example, before the general features of structure and form are presented, the displacement of certain supposed fault blocks is described on a purely topographic basis but with no mention of post-faulting erosion; the reader can form no independent judgment here until after he has read later pages, and not easily then. The manner of treatment also is unsatisfactory in several sections because it does not clearly enough recognize that every structural mass has a changing surface form and that the reader cannot acquire an understanding of the districts concerned unless the present phase of changing surface form, as well as the more constant underground structure of each mass, is explicitly stated. Sometimes important details concerning structure are wanting, as in an account of the backland, where the occurrence of Jurassic and Cretaceous formations is noted but without indication of the thickness or attitude of their strata.

An overeasiness acceptance of hypothetical displacements, above implied, is again seen in a brief account of coastal trends, which are ascribed in part to faulting; though it may well be believed that a true-scale section would show moderate flexures to be sufficient. Unfortunately, few sections are given, those few are grossly exaggerated vertically, and only one of them indicates underground structure; the others are drawn in solid black. Some of these, which by an entirely permissible reduction might be shortened to the breadth of a page so as to stand in proper attitude, have to be turned lengthwise along the page side, as a result of which their locality names are actually printed upside-down! The lack of carefully drawn structural sections seriously delays the understanding of the text; but the following physiographic relations appear to be indicated.

A hilly or mountainous backland, composed of gneiss, slates, and other rocks, and here and there reaching altitudes of from 600 to 1,000 meters at a distance of 20 or 30 miles from the sea, is unconformably blanketed in its lower areas with a heavy body of strata, sandy inland where their altitude is 200 or 300 meters and declining toward the coast where they become in part calcareous. Their surface is submaturely dissected by branching valleys, and the valleys are occupied up to 50 or 100 meters by a later series of sandy and loamy deposits which become confluent near the shore where they constitute a young coastal plain that is margined along the more advanced parts of the coast by a raised and clift coral reef 25 meters in altitude. A level limestone bench extends inland from the raised reef for an unspecified but apparently moderate distance and ends at an abrupt step which rises some 20 or 30 meters to the main area of the plain. The step and the bench in front of it are ascribed to former marine abrasion and correspond to similar features along the advanced shore of today. The inland branches of the coastal plain, which occupy the valleys of the uplands as above stated, are themselves as well as the forward part of the plain trenched by younger and narrower valleys, which are floored with flood plains, good for cotton culture, all the way to their mouths where the margin of the plain, retreating in two long bights, is cut back in sloping bluffs and fronted by shallow water; but where the margin of the plain advances in clift-reef headlands toward deep water between the two long, shallow bights, the valleys are entered by narrow salt-water embayments, which serve as excellent harbors. Beneath the clift-reef headlands of the advanced coast the deep-water shore is bordered by a well developed fringing reef, from half a mile to a mile wide; the shallow-water shores of the bights and the embayments are often bordered by mangrove swamps.

The coastal region, therefore, exhibits the records of three emergences and of as many submergences; the last submergence is thought, on rather insufficient grounds, to be still in progress. The elevated reef is one of the records of the second submergence; the sea-level fringing reef of the third. One of these widespread movements, perhaps the third one which is recorded by the emergence of the advanced headlands, seems to be responsible also for a down-warpage of the coast in the two long shallow bights just mentioned. The longer bight is in the northern half of the colony and has a chord length of 150 miles; it is occupied near its middle by the 50-by-20-mile island of Zanzibar, which consists of mainland strata in its western half and of uplifted reef limestones in its eastern half and which shows along its eastern side two-level abrasional features like those of the advanced mainland coast. The second bight is in the southern part of the coast and has a chord length of 120 miles; it is occupied near its middle by the 30-by-10-mile island of Mafia, which is rimmed on its outer side by a much narrower elevated reef than that of Zanzibar. Behind this island the bight is narrowed and shoaled by the advancing delta of the Rufiji, one of the largest rivers of the region; its numerous distributaries have lengths up to 30 miles, and the delta has a still longer sea front. Both bights are beset by many reef patches with occasional islets.

The advanced clift-reef coast occupies three stretches, outside of which a rapid descent is made to deep water. The northern stretch, continued from British East Africa, is 70 miles in length and is partly fronted by a discontinuous barrier reef, offshore from which lies the 40-by-20-mile island of Pemba, with an outer border of raised reef in simple outline and a minutely embayed inner border; between the island and the continent is a reef-free, deep-water passage, 30 miles in width. As Pemba, like Zanzibar, contains some mainland strata back of its elevated reef, the deep-water passage may be plausibly ascribed to down-flexing or down-faulting. Another stretch of advanced coast, 140 miles in length, lies in the south and continues into Portuguese East Africa; several of its embayments near the German boundary are associated with sharp inturns of the 200-meter submarine contour; close to the boundary the Rovuma, about as large a river as the Rufiji, still has an estuarine mouth. The third advanced coastal stretch separates the two bights and is only 30 miles in

length; near its northern end Dar-es-Salaam, the chief port of the coast, lies on a fine harbor embayment; the town of Zanzibar, not far away to the north, has a reef-enclosed harbor on the western side of its island.

The fivefold division of the coast, just described, is the most profitable physiographic lesson of Werth's book. It is given belated statement in the first part of the second volume. The above explanation of it by down-warping in association with the emergence of the elevated reef, as well as the changes of level inferred from the sandy and loamy deposits which occupy the valleys of the uplands and which are themselves trenched by narrower and partly embayed valleys, are based more on the geological map than on the text; but the map indicates them so clearly that the absence or obscurity of text statements concerning them is not easily understood. On the other hand, a redundant treatment of the abrasional features along the advanced coast is also difficult to understand; they are described first under "Küstenterrassen" on pages 22 to 24 and again under "Strandterrassen" on pages 49 to 51. One bite at that sort of a cherry should suffice. But there is, without question, a large body of physiographic information contained in the two volumes; and if the other chapters are as richly stored as the one here reviewed they are well worth working.

The book appears to have been prepared about the time the World War began and was published during its progress. It is dedicated to those who had already lost their lives in defending German possessions in East Africa. The coastal belt was selected for description because of its great importance in the further development of the colony. The many pages must, therefore, be sad reading to German readers under present conditions; but they must be of high value to the mandatar in whose charge the colony has been placed.

W. M. DAVIS

DUNES AND DUNE FORMATION

W. BEHRMANN. *Borkum: Strand- und Dünenstudien*. 40 pp.; map, ills. *Meereskunde* No. 153 (= Vol. 13, 1919, No. 9). Berlin.

Borkum, a well known bathing resort, situated at the mouth of the Ems, nine miles from the Dutch coast and between the channels called the Oster Ems and Wester Ems, is the westernmost of the East Frisian Islands. The island has grown together from two islands, which are even now so clearly indicated that they bear the distinctive names of Eastland and Westland. The small Eastland lies north of the larger Westland and is not so greatly exposed to the winds and waves as the latter. The islands were separated from each other from time to time up to 1863. Since then they have been joined by a dike, and the dunes on the north have been made artificially and ingeniously for the reinforcement of this dike. At some time sand comes to the island from all sides except the east, where there is a sand-clay flat. The waves and the tides tend to beat and to scour material from the west end and to drive it toward or to this sand-clay flat. But there are high dunes on the west and also a beach wall almost four kilometers long which protects the land from the violent beating of the waves. Before this wall was built the breakers had already reached the dunes; and there is a steady westward movement of the sands along shore which has formed and maintains the "Hohe Hörn." This movement of the sand of Borkum is like that of all the Frisian Islands, to the east. The Eastland, however, is not so strongly swept and scoured by the winds, waves, and tides as the Westland. The sand level on the North Strand is wonderfully maintained through the protective effect of the great horseshoe-shaped dune which covers a large part of Eastland.

The author discusses in detail the formation of rill- and ripple-marks on the beach, as well as the deeper channels that occur in front of the breakers; and he describes the occurrence of beach potholes, made by the fall of the stronger breakers, and the formation and breaching of beach walls. The incoming waves and tides normally bring in much more material to the shore than is carried away by the ebb, and in this way a beach wall 80 to 100 meters broad and 1½ meters high has been built up between the beach flats and the sea. The beach flats are growing in the east and breaking down in the west. One may observe on a portion of Borkum the base level due to deflation, and every phase of the work of wind and wave is here observed and described.

"The side on which the wind allows plants to grow promotes upbuilding and encourages animal and human life. The fowl world of the inner side is entirely different from that on